

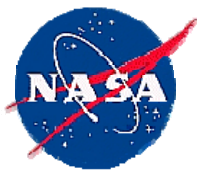


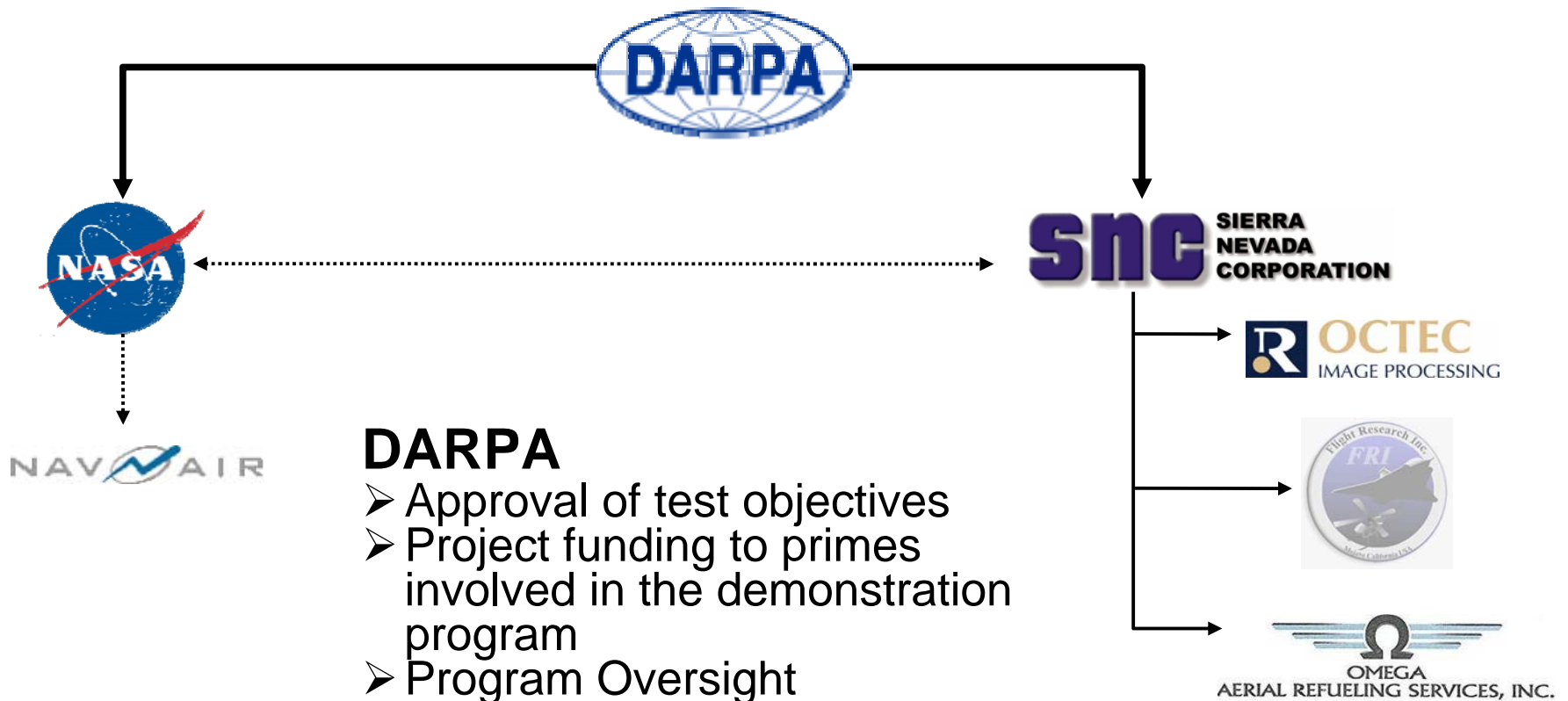
AARD - Autonomous Airborne Refueling Demonstration



Dick Ewers
DFRC, NASA

East Coast
SETP
Symposium
20 April 2007





DFRC

- Responsible Test organization
- Lead system integrator
- Responsible for system airworthiness
- Responsible for flight safety

SNC Development Team

- Overall test leader
- AARD Controller development
- Responsible for mission success
- Responsible for contracting Omega tanker activities.
- Support integration, airworthiness and flight test activities.



Program Goals

➤ Primary Objective

- ⇒ To make one **fully automatic** probe-to-drogue engagement using the AARD system.

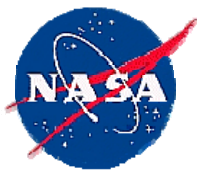
➤ Success Criteria

- ⇒ One successful automatic engagement from the trail position (planned 100 ft from drogue) to basket connection
- ⇒ Hold connected to simulate a complete refueling sequence (planned for 5 minutes) then automatically disconnect and return to trail
- ⇒ Record on video – (with Pilot's hands in the air!!)



- The Basket Can Strike Back





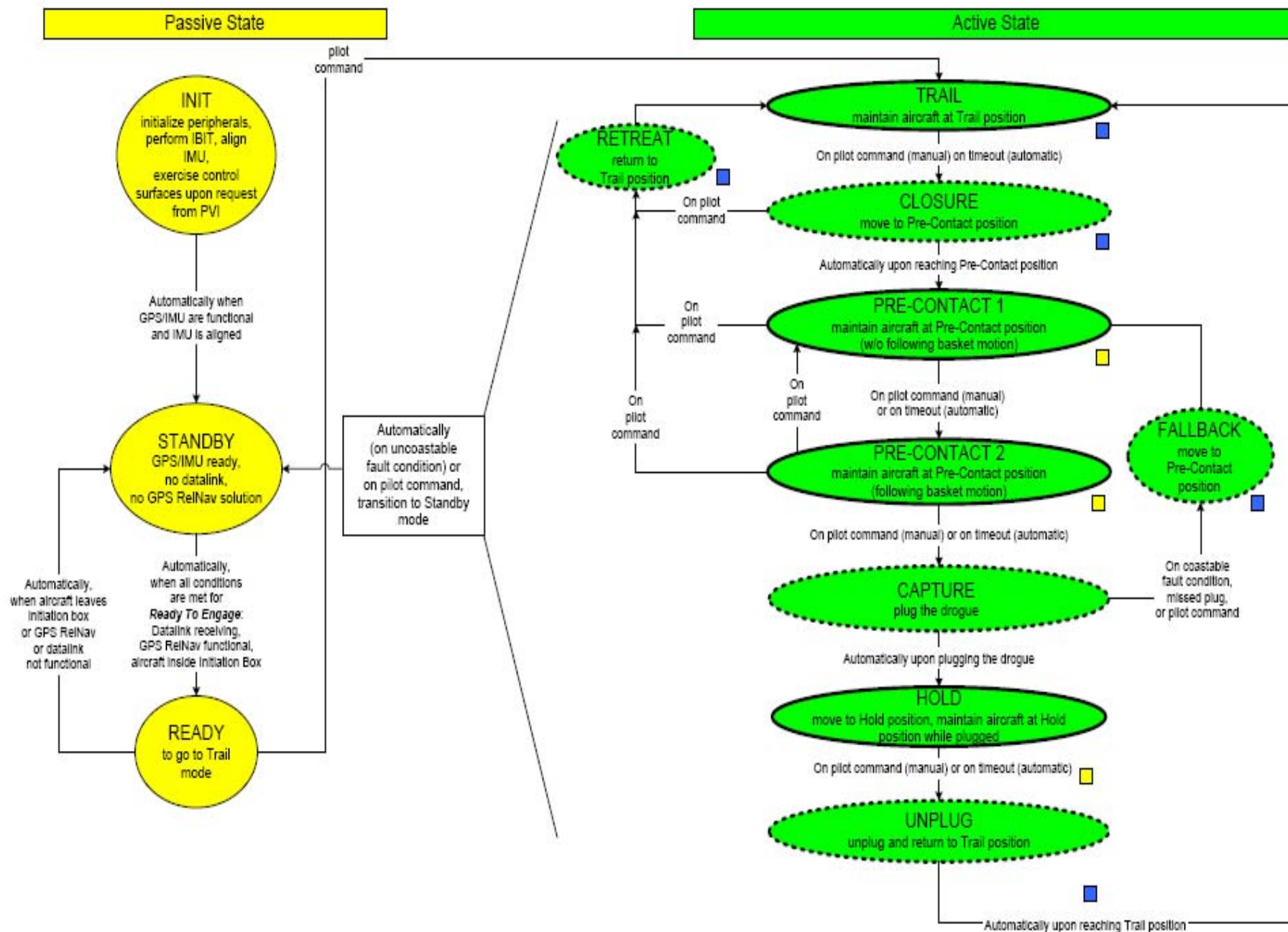
System Design

➤ Tanker System

- ⇒ GPS Pallet Transmitting Position & Velocity
- ⇒ **No** Modifications to Drogue Refuel System

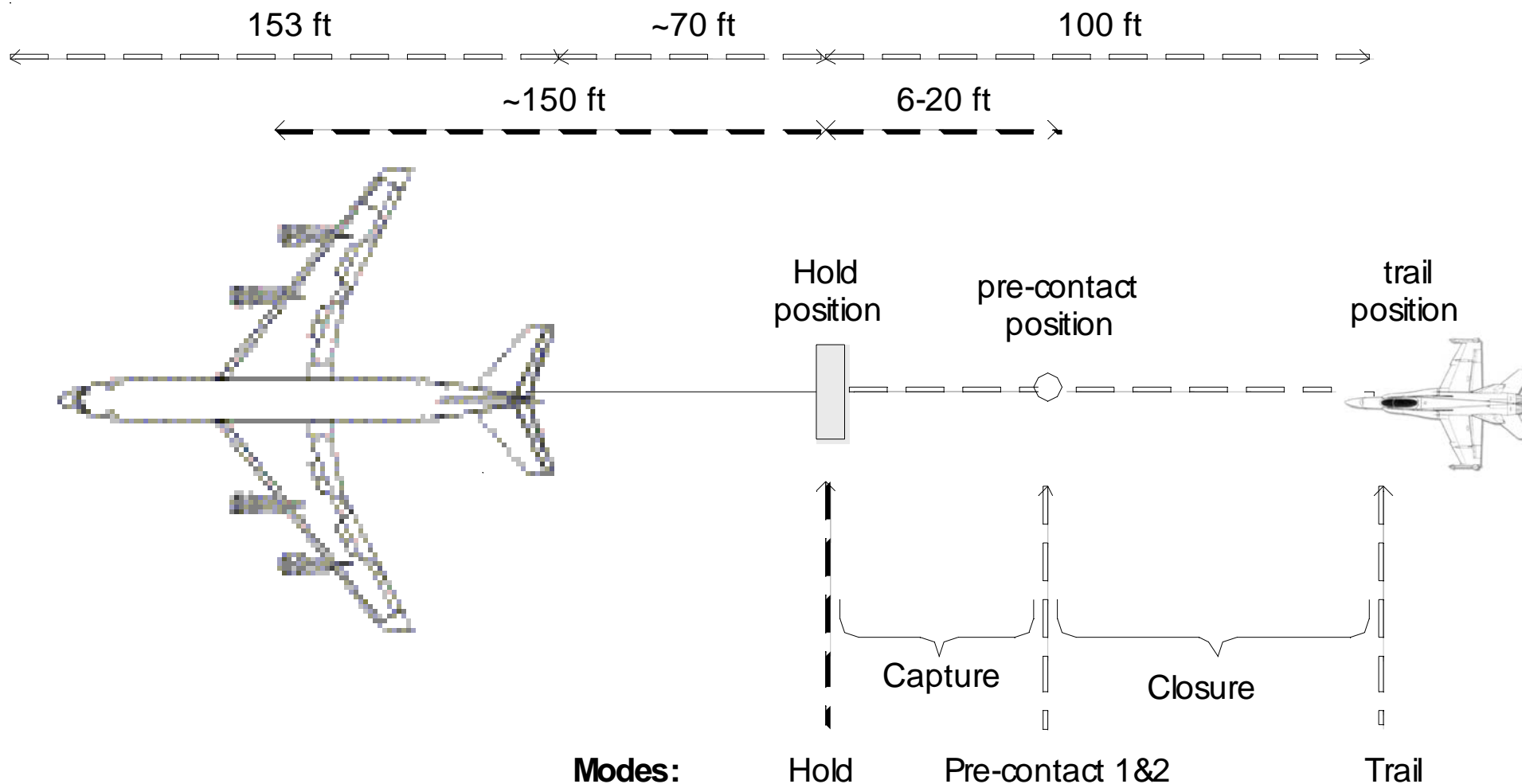
➤ F/A-18 System

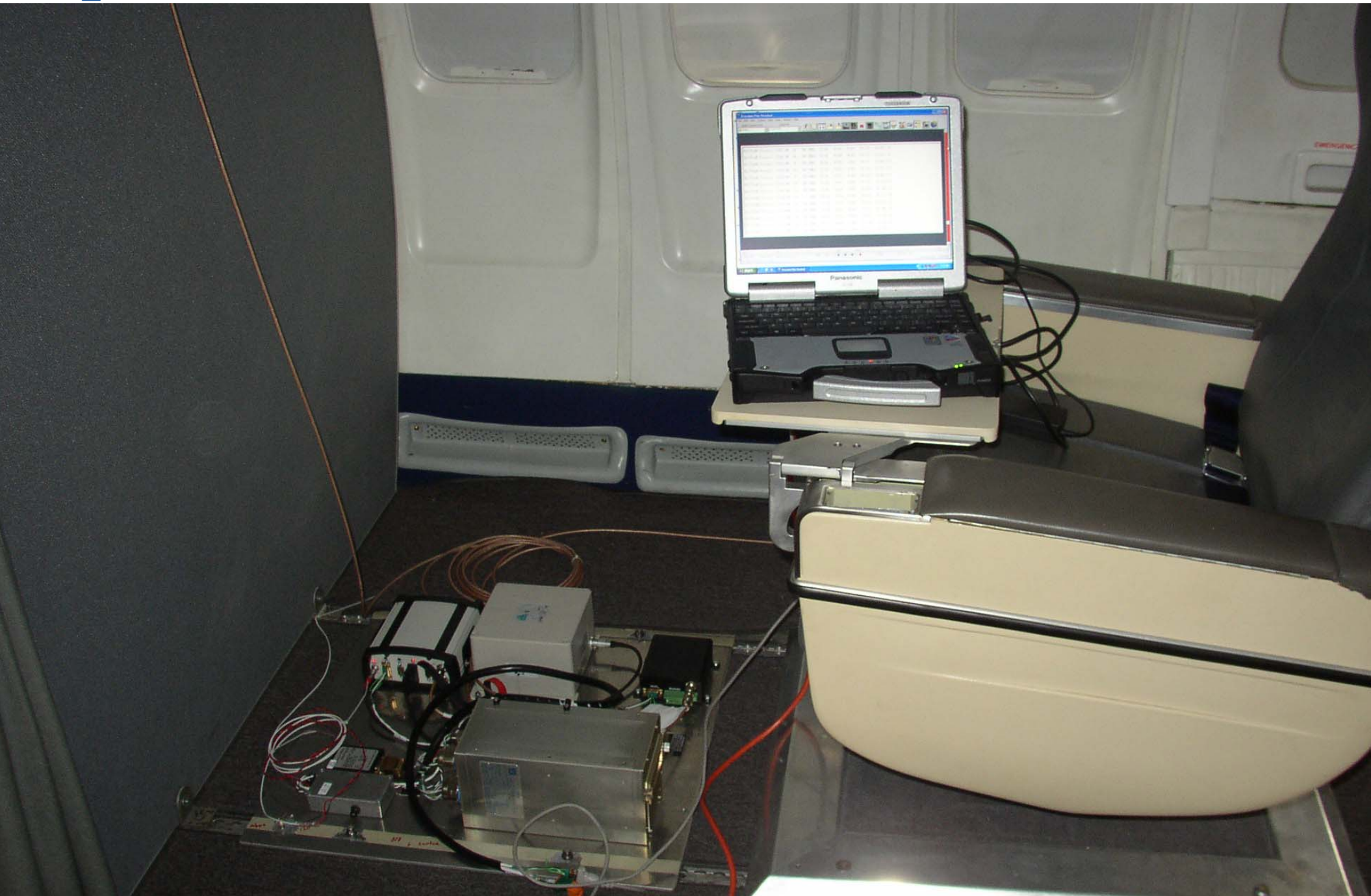
- ⇒ GPS & Receiver; "Rel-Nav" Solution
- ⇒ Optical Tracker; Basket Capture Solution
- ⇒ AARD Computer to Replace Pilot Inputs
- ⇒ PVI Panel

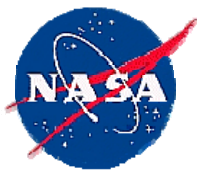




Pictorial View

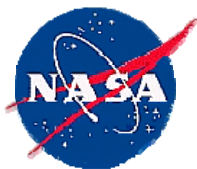






AARD Controller





Rear Cockpit PVI





PVI Controller

- Eight active push tiles with information

Stndby

Close

X: xxx
Y: xxx

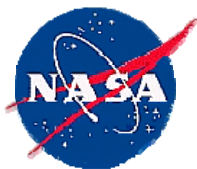
Z: xxx

Forcef
Off

Manual

AARD
OK

Trail



Front Cockpit

- Canopy bow status lights
- Optical tracker camera
- Video selector
- DDI RFCS control







Validation Flights

- 4 Flights with Sabreliner Surrogate Tanker: 16 – 29 June 2006
- 3 Flights with Sabreliner in second phase: Nov 2006 – Mar 2007





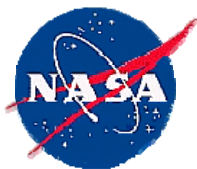
Omega Tanker Flights

9 Flights with Omega tanker:

- ⇒ 11 July '06: Optical tracker problems
- ⇒ 27 July '06: Optical tracker problems
- ⇒ 17 Aug '06: Data Link problems, Optical tracker OK
- ⇒ 30 Aug '06: **SUCCESS**

- ⇒ 13 Dec '07: Plugs
- ⇒ 22 Feb '07: Plugs in a turn
- ⇒ 23 Mar '07: Plugs in turbulence
- ⇒ 16 Apr '07: Plugs in turbulence
- ⇒ 17 Apr '07: Plugs in turns





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A-089.24° E-088.36° A-017.56° AMOS TM30 T P0 F10753

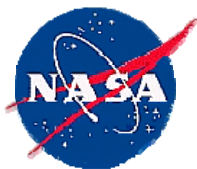
BACQ: HTT-81 LILYARD

242-16-16-55-377



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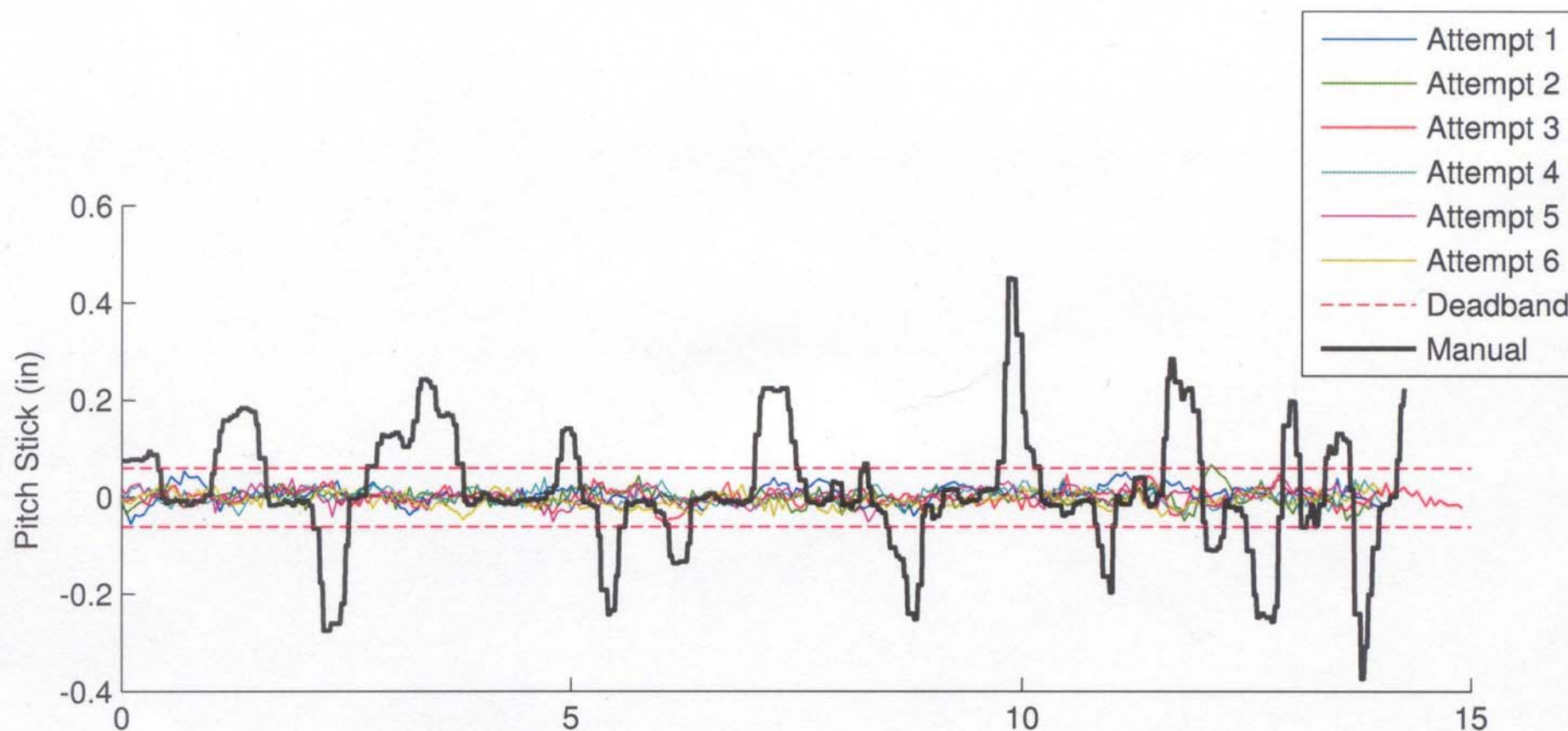


Turbulence





“Stick” Measurements





Lessons Learned

- **Early Pilot Involvement**
- **Computers Remove “Human” Problems**
- **Shortcuts Seldom Work**
- **“SHIT” Happens: (*S*oftware / *H*ardware *I*nduced *T*rauma)**



Possible Users





Questions???



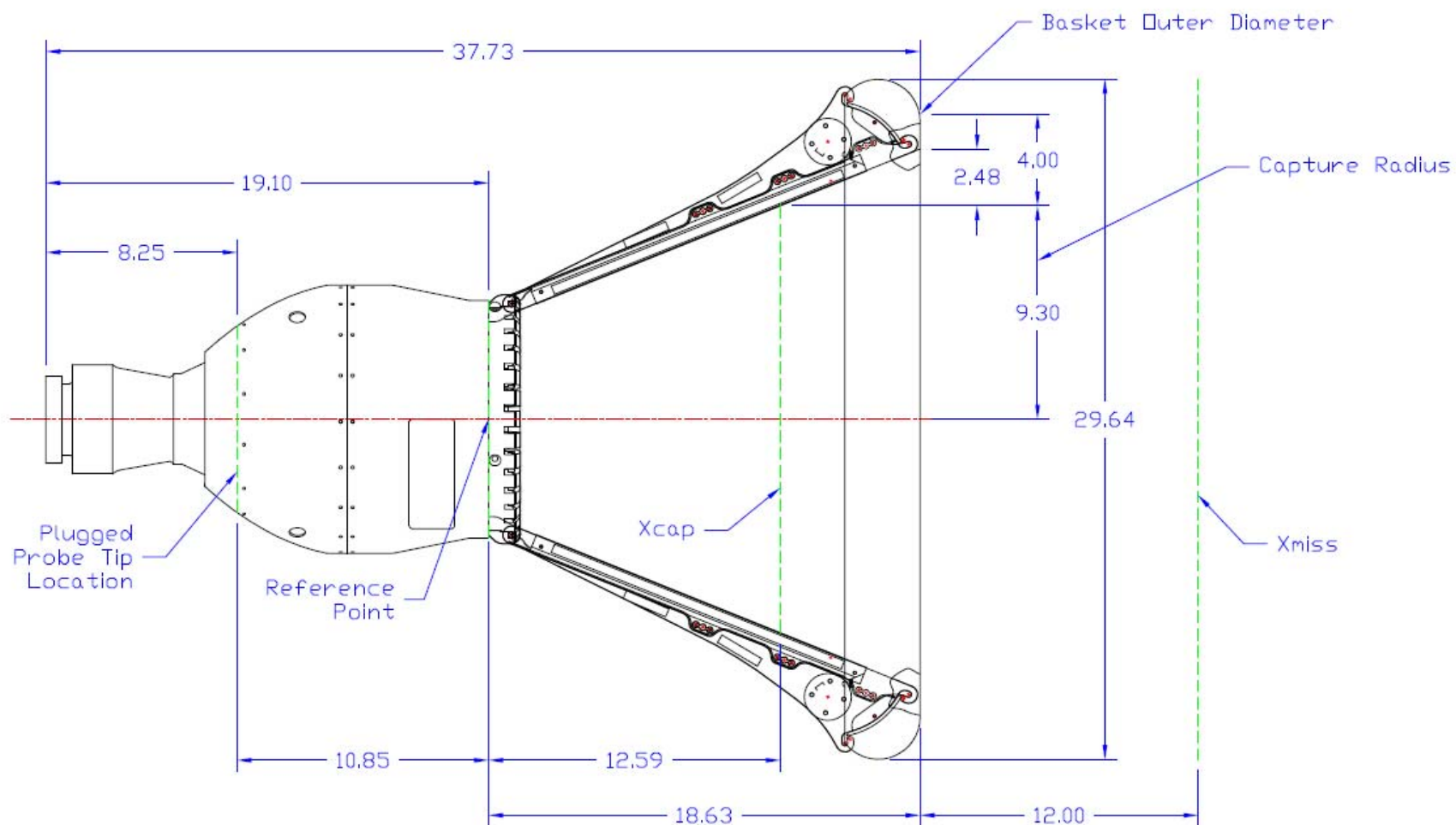
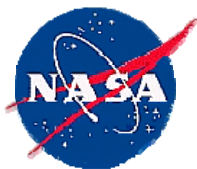


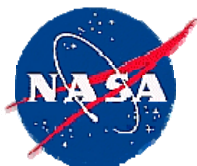


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A-013.82° E+003.74° R+136.77ft AM02 TM10 S P0

BAC08 MTT-B1 TRK:AARD

2008-17-30-05-206



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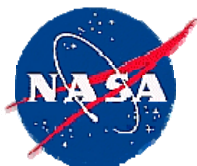
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PSFCC's

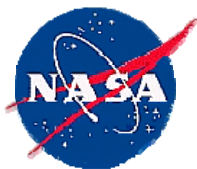






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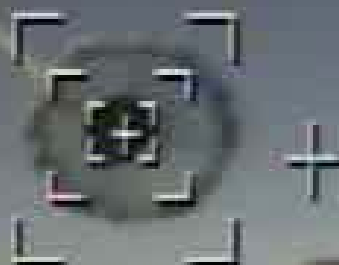






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A-004.25° E+000.56° R+030.83ft AM03 TM30 T P0 F44



BACQ: MTT-B1 LINKBAARD

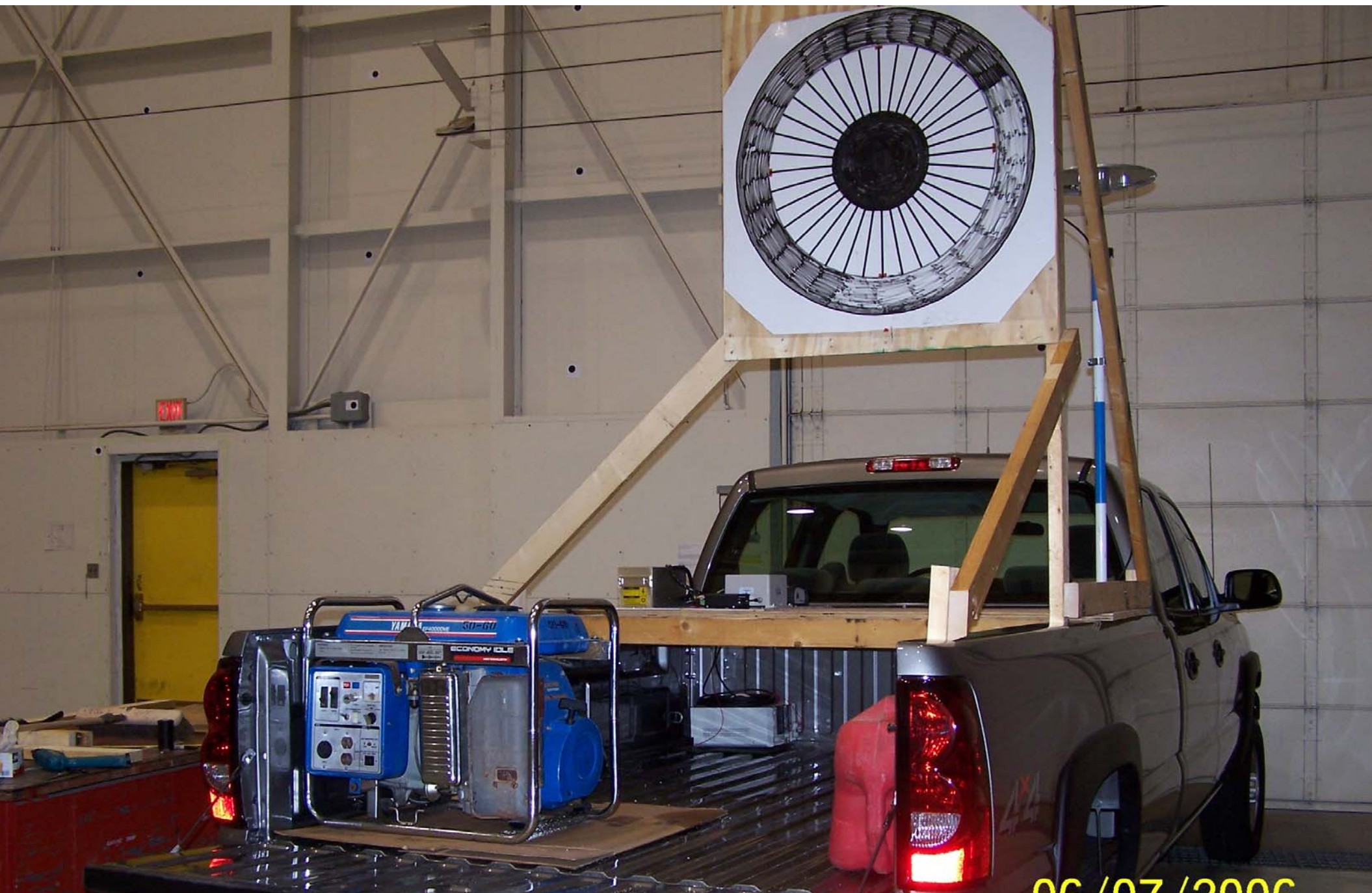
208:17:09:13.022





Front Cockpit Glareshield





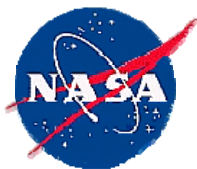
06/07/2006

A-005.58° E-002.40° R+016.10ft AM03 TM30 T P0 F511

BACQ: MTT-B1 UJBAARD

229:16:30:12:791



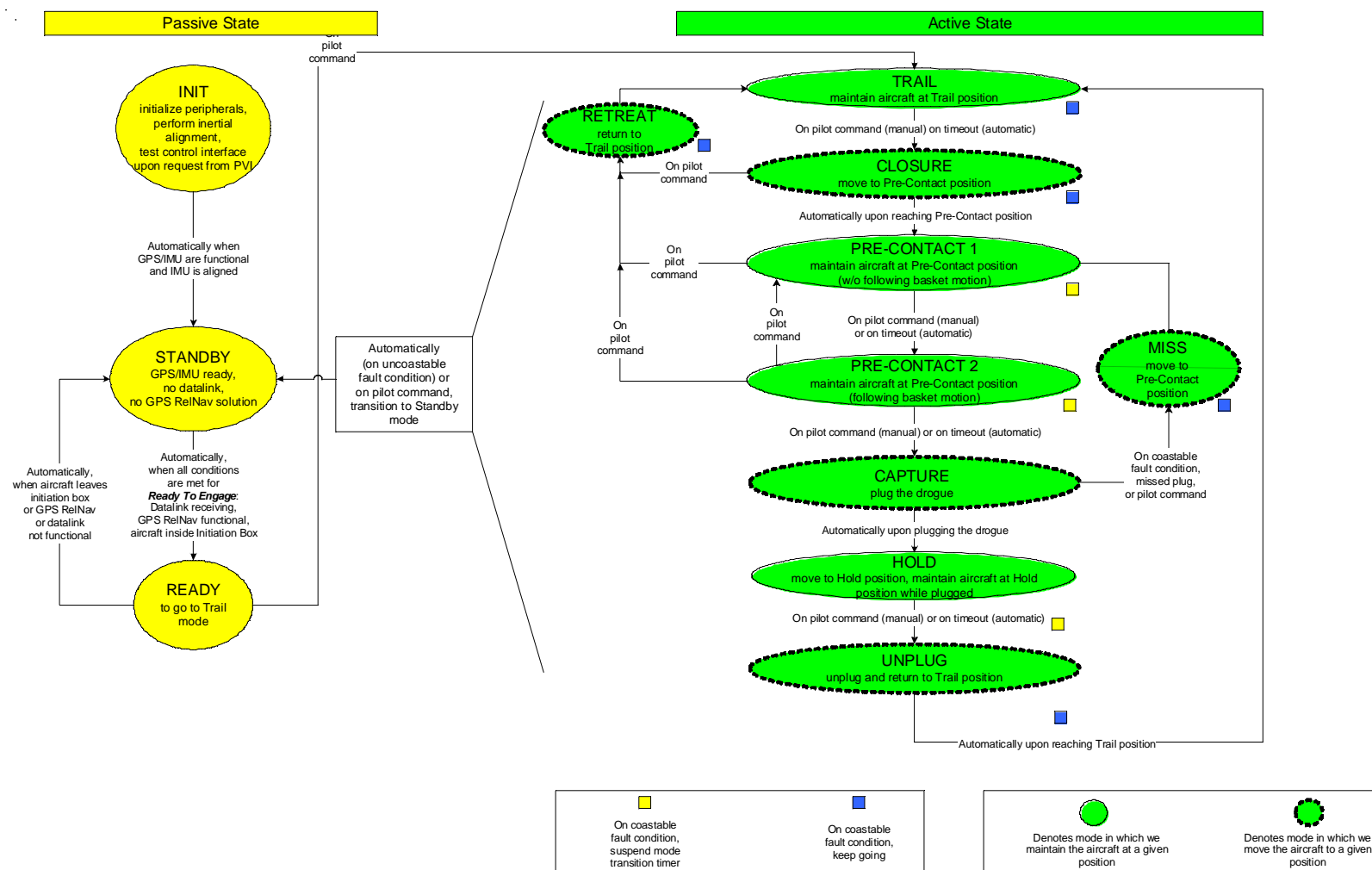


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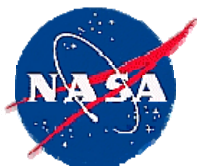
Receiver States and Modes





AARD Test Program

- Background
- Participants
- Design
- Simulation and Ground testing
- Test Flights:
 - ⇒ With surrogate tanker
 - ⇒ With Omega tanker
 - Optical system problems
 - Rel-Nav problems
- 30 August 2006



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